CONSOLIDATED INFORMATION TECHNOLOGY SERVICES
TASK ASSIGNMENT (TA)

1. **TITLE:** (D318) Development and Enhancement of ATOS System Software to Support NGATS ATM Airspace Project

TA No:	RDO006-Rev6	
Task Area Monitor:	**Alternate Task Area Monitor:**	
NASA POC:	**Software Control Class:**	Low Control
Type of Task:	Recurring Task	

2. BACKGROUND

The JPDO NGATS FY08 Agency Budget Guidance calls for NASA research in many areas with the largest effort called for in the Aircraft Trajectory-Based Operations capability. It requests NASA research, working closely with the FAA, to develop methods and tools to inform design decisions on the allocation of NGATS functions between service provider and user and automation and human operators. NASA's interpretation of this guidance is to apply its capabilities and core competencies to develop methodologies and techniques to minimize or solve the demand/capacity imbalance problem in the NGATS future, building on the science of trajectory prediction. NASA proposed research for this critical need is described in the Dynamic Airspace Configuration (DAC) and Traffic Flow management (TFM) technical sub-sections. NASA also proposes research in the Separation Assurance (SA) and Airspace Super Density Operations (ASDO) technical sections where we will develop concepts and technologies that significantly increase the capacity of the NAS. This represents NASAs response to the overarching JPDO capacity requirements. Through analyses, prototyping, and the conduct of laboratory-based simulations and in special cases flight evaluations NASA with the JPDO, industry and academic partners will develop and provide design information to reduce the technical risk of a highly automated NGATS.

3. OBJECTIVE

The objective of this task is to develop and enhance the simulation capabilities of the simulation research system developed for ATOL and support NASA NGATS Airspace project research in the following research focus areas (RFAs):

Trajectory Projection Synthesis Uncertainty (TPSU)

Transitioning Air Traffic Management (ATM) from airspace-based to trajectory-based operations represents a significant historic alignment of NAS users and Air Traffic Service Providers (ATSPs). Currently, user operations are trajectory-oriented. For example, pilots control their aircraft trajectories, and Airline Operational Control (AOC) centers manage city-pairs (i.e., trajectory-oriented). On the other hand, ATSPs are geographically and spatially oriented (i.e., airspace-oriented). This discrepancy of operations requires users to adjust

their trajectories to accommodate the structure and capacity of a static nearly homogenous airspace. Transitioning ATM to Trajectory-Based Operations (TBO) will enable a more efficient ATM system that better accommodates user-preferred operations. The expected benefits are 1) more efficient use of airspace, 2) better accommodation of user preferences, 3) increased system capacity through a reduction in human operator workload, and 4) increased trajectory predictability, thus allowing precise use of all NAS capacity. Finally, TBO will provide the ability to make best use of deterministic and stochastic information over appropriate planning intervals.

JPDO-defined TBO is intended to serve two roles in the NGATS ATM-Airspace project. First, TBO provides a guiding philosophy for the system design of operational concepts and their associated ATM functions (e.g., TFM, separation assurance). By applying the principles of trajectory-based operations to these concepts and functions, the benefits described above can be more readily pursued. Second, TBO consists of research activities focused on advancing the state-of-the-art of trajectory modeling and prediction for the benefit of the various ATM functions. Using the basic principles of 4D trajectory modeling, one can theoretically predict future trajectories of aircraft within the NAS such that demand/capacity imbalances and aircraft separation conflicts can be detected. Advancements in trajectory prediction will enable ATM functions developed in the other technical areas such as Dynamic Airspace Configuration, Traffic Flow Management, Separation Assurance, and Airspace Super Density Operations to actively mitigate imbalances and resolve conflicts, while minimizing the impact to the users preferred trajectories. Trajectory prediction always involves some degree of uncertainty, which can vary dramatically depending on modeling assumptions. Operational concepts must account for uncertainty. The two principal areas of research proposed for TPSU are fundamental trajectory modeling and estimating and accommodating trajectory prediction uncertainty.

Airspace Super Density Operations (ASDO)

Airspace Super-Density Operations (ASDO) refers to highly efficient operations at the busiest airports and terminal airspace. The Separation Assurance research approach is aided by the extensive degrees-of-freedom (DOF) afforded aircraft in the cruise and transition airspace which could enable 2-3x capacity, how this drastic increase in traffic will be managed in the terminal domain is not as evident. The JPDO envisions a combination of new technologies enabling significant growth at large airports and increased operations at underutilized airports to absorb the expected increase. These operations need to be robust to the various business uses of the NAS including the hub-and-spoke (just-in-time) service that demands high capacity, tight scheduling, and predictable operations. This is to be done in the presence of the extreme challenge for the simultaneous satisfaction of precision sequencing, merging, spacing, and de-confliction requirements while using the airspace in an environmentally friendly fashion. This problem is well beyond the capability of any known approaches to multi-objective optimization. Coupling the problem with the wide breadth of aircraft performance contributing in a combinatorial fashion, severely limits the DOF of a possible solutions space.

Performance Based Services (PBS)

A key NGATS capability is Performance-Based Services (PBS) that match Air Navigation Service Provider (ANSP) service levels to user performance capabilities across all flight domains and operational constraints. Defining multiple service levels will address a wide

range of user needs while encouraging more private sector innovation and free market decision making. PBS allows users to select the performance level appropriate for their particular operation and surpasses the need to dictate specific equipment requirements. PBS is also a tool for controlling access to highly constrained resources and/or complex operating environments. Understanding and defining this performance framework, its associated levels of performance, and the commensurate levels of service, are critical steps toward reaching the NGATS vision.

PBS combines the fundamental building blocks of Required Navigation Performance (RNP), Required Communication Performance (RCP) and Required Surveillance Performance (RSP) into the aggregate multi-dimensional parameter of Required Total System Performance (RTSP). These three RTSP components are generally in the formative stages of definition with the following order of maturity: RNP (high), RCP (medium), and RSP (low). Research is needed to accelerate the completion of the definitions, to link them to the appropriate ANSP service levels, and to assess their impact on integrated system performance.

NASA research in PBS concepts will provide increased focus on an area that is foundational and critical to the NGATS vision and architecture. The work to quantify the performance levels achievable by aircraft must be conducted before system-level performance of integrated air/ground concepts can be measured. NASA will produce definitions of RNP, RCP, and RSP that are capable of supporting proposed NGATS concepts. In addition, it will provide a framework to assess performance requirements for various proposed concepts of operation.

Separation Assurance (SA)

In todays operations air traffic controllers provide separation assurance (SA) by visual and cognitive analysis of a traffic display and issuing control clearances to pilots by voice communication. Decision Support Tools (DSTs) deployed in recent years provide trajectory-based advisory information to assist controllers with conflict detection and resolution, arrival metering, and other tasks. DSTs have reduced delays, but are not expected to support a substantial increase in airspace capacity. And efforts to reduce airspace sector size have reached a point of diminishing returns. The human controllers cognitive ability to monitor a radar display and ensure separation for no more than about 15 aircraft (± 2 or 3 traffic complexity dependent) prevents a substantial increase in capacity.

A fundamental transformation of the way SA is provided is needed to achieve NGATS 2025 objectives. The JPDO envisions higher levels of automation and a more optimal allocation of SA functions between automation systems and human operators, and between central service providers and aircraft operators. The overarching research problem for SA is to identify trajectory-based technologies and human/machine operating concepts that could support a substantial increase in capacity (e.g., 2-3x) with safety under nominal and failure recovery operations, with airspace user preference and with favorable cost/benefit ratios.

1. GENERAL IT SUPPORT SERVICES

Services Specified Through Exhibit A:
System administration and information technology services will be provided to support

computers, as described and listed within Exhibit A, used by researchers and civil servants involved in this area of research. These computers are all NASA computers located onsite but not associated with research computers within the ATOL. It is assumed that any COTS software needed to support the task and is required to be on the computers described herein will be provided by NASA and that hardcopies of the software will be provided to the System Administrator in the event that the software needs to be removed, updated and/or reinstalled.

Exceptions and Additional Requirements:
NASA personnel and contract researchers with support computers, as described and listed within Exhibit A, residing outside ATOL will be using either ODIN backup and recovery services or personal external backup drives for data backup and recovery. Raytheon will not provide data backup and recovery services to these computers as part of this task. Consequently, in the event of data loss, Raytheon will not be held responsible for such loss. This is also not a hardware maintenance task. The System Administrator will hardware troubleshoot machines and report issues back to the NASA point of contact for purchase or repair which will be at the expense of NASA.

General IT Support Services Performance Metrics

Performance Standard: Performance Standard: The contractor delivers product within costs and schedule.

Performance Metrics:

- Exceeds: The contractor delivers application to the customer prior to scheduled delivery date and under cost.
- Meets: The contractor delivers application to the customer on scheduled delivery date and within cost.
- Fails: The contractor delivers application to the customer after scheduled delivery date and/or exceeds stated cost by more than ten percent.

Performance Standard: Product quality meets customer expectations.

Performance Metrics:

- Exceeds: Product performance exceeds customer's documented requirements and expectations. Product provides service to the customer beyond anticipated use requirements. Customer provides written or verbal communication indicating the same.
- Meets: The product performs as documented in the requirements and meets customer needs. Customer is satisfied with product and uses in the manner intended.
- Fails: Product does not perform as documented in the requirements and customer expectations are not met. Customer is not satisfied with product and cannot use in the manner intended.

2. SYSTEM AND APPLICATION DEVELOPMENT SERVICES

Project Title: Trajectory Projection Synthesis Uncertainty (TPSU)

LaRC Software Manager:

Software Software Control Class: Low

Responsibilities of Contractor and LaRC personnel:NASA will provide the Contractor with access to the Air Traffic Operations Lab (ATOL), appropriate computer software licenses, and computer equipment located at Langley Research Center for development, integration, and test of all software developed in support of this RFA. NASA will provide requirements and concept of operations documentation and software as described in the projects. The availability of any Government-provided software and documentation will depend on release dates, rights in data, and may require nondisclosure agreements to be executed. The Contractor will provide design, development, integration and testing against the requirements and concepts as conveyed by NASA. The Contractor will provide support to NASA researchers in defining and testing experiment scenarios, in running experiments, and in collecting experiment data.

Requirements:

* The contractor shall participate as members of the Systems Engineering Management Team (SEMT).
* The contractor shall produce a schedule with identifiable tasks and milestones so that incremental progress can be quantitatively measured.
* The contractor shall support NASA in feasibility studies, concept of operations and general research.
* The contractor shall support NASA in scenario designs.
* The contractor shall support NASA in demonstrations.
* The contractor shall support NASA in experiments and post-run data analysis.
* The contractor shall design and develop software that will support the concepts and requirements as documented by NASA.
* The contractor shall conduct a Design Review (DR) on the design of all new features.
* The contractor shall perform system integration testing on all software that exercises all functional capabilities applicable to planned or intended research experiments.
* The contractor shall provide testing results and procedures as part of the incremental build release documentation.
* The contractor shall lead the system integration effort associated with all software developed under this task as well as any government furnished software and equipment.
* The contractor shall perform software maintenance during the integration and test phases of development to include software problem reporting, recommended fixes, impacts to other software, recommended enhancements, etc.
* Contractor developed software shall be provided to NASA for unrestricted use and duplication by NASA.
* NASA may approve limited exceptions if benefit to the project can be justified.

Constraints:

To the extend possible, the following constraints apply:

* Programming Language C++, JAVA and scripting languages.
* Platform and Operating system independent code.

Acceptance Criteria:

Delivery of product deemed complete once deliverables have
a) had a successful customer-witnessed sell-off
b) been submitted into ClearCase with an email trail indicating submittal and confirmation.

Project Title: Airspace Super Density Operations (ASDO)

LaRC Software Manager:

Software Software Control Class: Low

Responsibilities of Contractor and LaRC personnel:NASA will provide the Contractor with access to the Air Traffic Operations Lab (ATOL), appropriate computer software licenses, and computer equipment located at Langley Research Center for development, integration, and test of all software developed in support of this RFA. NASA will provide requirements and concept of operations documentation and software as described in the projects. The availability of any Government-provided software and documentation will depend on release dates, rights in data, and may require nondisclosure agreements to be executed. The Contractor will provide design, development, integration and testing against the requirements and concepts as conveyed by NASA. The Contractor will provide support to NASA researchers in defining and testing experiment scenarios, in running experiments, and in collecting experiment data.

Requirements:

* The contractor shall participate as members of the Systems Engineering Management Team (SEMT).
* The contractor shall produce a schedule with identifiable tasks and milestones so that incremental progress can be quantitatively measured.
* The contractor shall support NASA in feasibility studies, concept of operations and general research.
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* The contractor shall support NASA in demonstrations.
* The contractor shall support NASA in experiments and post-run data analysis.
* The contractor shall design and develop software that will support the concepts and requirements as documented by NASA.
* The contractor shall conduct a Design Review (DR) on the design of all new features.
* The contractor shall perform system integration testing on all software that exercises all functional capabilities applicable to planned or intended research experiments.
* The contractor shall provide testing results and procedures as part of the incremental build release documentation.
* The contractor shall lead the system integration effort associated with all software developed under this task as well as any government furnished software and equipment.
* The contractor shall perform software maintenance during the integration and test phases of development to include software problem reporting, recommended fixes, impacts to other software, recommended enhancements, etc.
* Contractor developed software shall be provided to NASA for unrestricted use and duplication by NASA.
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Constraints:

To the extend possible, the following constraints apply:

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* Platform and Operating system independent code.

Acceptance Criteria:

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a) had a successful customer-witnessed sell-off
b) been submitted into ClearCase with an email trail indicating submittal and confirmation.

Project Title: Performance Based Services (PBS)

LaRC Software Manager:

Software Software Control Class: Low

Responsibilities of Contractor and LaRC personnel:NASA will provide the Contractor with access to the Air Traffic Operations Lab (ATOL), appropriate computer software licenses, and computer equipment located at Langley Research Center for development, integration, and test of all software developed in support of this RFA. NASA will provide requirements and concept of operations documentation and software as described in the projects. The availability of any Government-provided software and documentation will depend on release dates, rights in data, and may require nondisclosure agreements to be executed. The Contractor will provide design, development, integration and testing against the requirements and concepts as conveyed by NASA. The Contractor will provide support to NASA researchers in defining and testing experiment scenarios, in running experiments, and in collecting experiment data.

Requirements:
* The contractor shall participate as members of the Systems Engineering Management Team (SEMT).
* The contractor shall produce a schedule with identifiable tasks and milestones so that incremental progress can be quantitatively measured.
* The contractor shall support NASA in feasibility studies, concept of operations and general research.
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* The contractor shall perform software maintenance during the integration and test phases of development to include software problem reporting, recommended fixes, impacts to other software, recommended enhancements, etc.
* Contractor developed software shall be provided to NASA for unrestricted use and duplication by NASA.
* NASA may approve limited exceptions if benefit to the project can be justified.

Constraints:
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* Programming Language C++, JAVA and scripting languages.
* Platform and Operating system independent code.

Acceptance Criteria:
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b) been submitted into ClearCase with an email trail indicating submittal and confirmation.

Project Title: Separation Assurance (SA)

LaRC Software Manager:

Software Software Control Class: Low

Responsibilities of Contractor and LaRC personnel:NASA will provide the Contractor with access to the Air Traffic Operations Lab (ATOL), appropriate computer software licenses, and computer equipment located at Langley Research Center for development, integration, and test of all software developed in support of this RFA. NASA will provide requirements and concept of operations documentation and software as described in the projects. The availability of any Government-provided software and documentation will depend on release dates, rights in data, and may require nondisclosure agreements to be executed. The Contractor will provide design, development, integration and testing against the requirements and concepts as conveyed by NASA. The Contractor will provide support to NASA researchers in defining and testing experiment scenarios, in running experiments, and in collecting experiment data.

Requirements:
* The contractor shall participate as members of the Systems Engineering Management Team (SEMT).
* The contractor shall produce a schedule with identifiable tasks and milestones so that incremental progress can be quantitatively measured.
* The contractor shall support NASA in feasibility studies, concept of operations and general research.
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* Platform and Operating system independent code.

Acceptance Criteria:
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b) been submitted into ClearCase with an email trail indicating submittal and confirmation.

Project Title: ATOL Lab Support

LaRC Software Manager:

Software Software Control Class: Low

Responsibilities of Contractor and LaRC personnel:NASA will provide the Contractor with access to the Air Traffic Operations Lab (ATOL), appropriate computer software licenses, and computer equipment located at Langley Research Center for development, integration, and test of all software developed in support of this task. The Contractor will take on the responsibility of support this laboratory via a Lab Assistant, from software and hardware installation and setup, testing, data archival, demonstrations, experiment support and general support to properly run the lab. System administration and information technology services will also be provided to support computers outside the ATOL used by researchers and civil servants involved in this area of research.

Requirements:
* The Contractor will provide lab management support for the ATOL.
* The Contractor will provide system administration and information technology services to support computers outside the ATOL used by researchers and civil servants for this area of research.

3. WORK-AREA SPECIFIC SERVICES

None required.

4. Exhibit A

Exhibit A

5. SPECIAL SECURITY REQUIREMENTS

The Contractor will comply with NASA security requirements applicable to employment of foreign nationals.

6. SOFTWARE ENGINEERING PROCESS REQUIREMENTS

* The contractor shall follow the existing Software Development Plan (SDP) and Configuration Management Plan (CMP).

* The contractor shall manage version control using the established Rational ClearCase environment unless otherwise specified by the Government.

7. JOINT REVIEW SCHEDULE

The contractor shall participate as a member of the SEMT in weekly update meetings to review/discuss progress and issues related to the task.

8. PERIOD OF PERFORMANCE

This TA is effective from 02/01/08 to 04/27/09

9. TECHNICAL PERFORMANCE RATING

Quality is important, but delivery on schedule is also required for the success of this project.

Quality: 70% Timeliness: 30%

10. RESPONSE REQUIREMENTS

This Task Plan shall address the contractor's specific work plans, associated estimated labor hours, cost and schedule.

11. GOVERNMENT ESTIMATED COST

12. FUNDING INFORMATION

Funding has not been entered for this TA.

13. MILESTONES

Date	MileStones
09/30/2008	Build 7 Sell-Off
01/31/2009	Build 8 Sell-Off

14. DELIVERABLES

Number	Deliverable Item	Deliverable Schedule
1	Build 7 Simulation System	9/30/2008
2	Build 7 Documentation	9/30/2008
3	Build 8 Simulation System	1/31/2009
4	Build 8 Documentation	1/31/2009

15. FILE ATTACHMENTS

None.